2014 DOE Solid-State Lighting R&D Workshop Agenda

January 28–30, 2014 • Tampa, FL

TUESDAY, JANUARY 28, 2014	
PLENARY SESSIONS	
1:00 p.m.	**WELCOME & INTRODUCTION** JAMES BRODRICK, U.S. DEPARTMENT OF ENERGY
1:30 p.m.	**THE NEXT FRONTIER IN SSL: CREATING NEW VALUE WITH INTELLIGENT, EFFECTIVE LIGHTING** BRIAN CHEMEL, DIGITAL LUMENS After years of focused research and development, we now know how to make the light. But how can we use it most effectively? Our industry is making huge strides in price and performance, but it is equally important to focus on two factors driving the next wave of innovation—utilizing photons wisely and creating new value with lighting. This talk will outline how the next phase of the LED revolution will be driven by widespread intelligent lighting that balances productivity and energy savings, and brings new, high-value lighting capabilities to end users.
2:15 p.m.	**THE EVOLUTION OF ADOPTION** BRAD KOERNER, PHILIPS LIGHTING LED lighting products have made serious inroads into a number of lighting applications. Adoption in these applications has been driven by performance and economics of the LED products. Looking forward, how will SSL products evolve to be competitive in more applications and eventually dominate the lighting market? Will R&D investment in sustainable materials and technologies lead to radical cost reductions of SSL systems to enable more widespread adoption? How can the lighting industry embrace the concepts of the "Performance Economy," where suppliers offer customers holistic added value solutions, and the "Circular Economy," where industry profitability is divorced from natural resource consumption to create an economically and environmentally sustainable lighting industry?
3:00 p.m.	Refreshment Break
3:30 p.m.	**PANEL | SSL SCIENCE CHALLENGES** MODERATOR: MORGAN PATTISON, SSLS, INC. NATHAN GARDNER, GLO-USA CLAUDE WEISBUCH, UNIVERSITY OF CALIFORNIA, SANTA BARBARA JULIAN OSINSKI, PACIFIC LIGHT TECHNOLOGIES While considerable progress has been made in understanding the science behind LEDs, some mysteries remain. Improving our understanding of the science behind SSL emitters not only satisfies our intellectual curiosity but has real world implications in terms of the performance and cost of SSL products. This panel will discuss these underlying scientific challenges and the benefits of developing an improved understanding of the science behind these phenomena.
5:00 p.m.	Adjourn
7:00 p.m.	**OPTIONAL BUS TOUR OF LED LIGHTING INSTALLATIONS *(Registration Required)*** Guided tour will visit Tampa LED lighting systems in action in commercial, medical, and retail applications.

WEDNESDAY, JANUARY 29, 2014	
7:30 a.m.	Continental Breakfast
PLENARY SESSIONS	
8:00 a.m.	**DOE SSL R&D PROGRAM DIRECTION** JAMES BRODRICK, U.S. DEPARTMENT OF ENERGY An overview of the DOE SSL R&D program direction, portfolio, budget, and areas of focus.
8:30 a.m.	**NIST RESEARCH ON COLOR QUALITY OF SSL SOURCES** YOSHI OHNO, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY An update on DOE-funded research conducted by the National Institute of Standards and Technology to improve our understanding of issues related to color quality of SSL sources, including the results of NIST's new chromaticity study.
9:00 a.m.	**A BROADER LOOK AT GOVERNMENT SUPPORT** JOEL CHADDOCK, NATIONAL ENERGY TECHNOLOGY LABORATORY STEVEN KONSEK, NATIONAL SCIENCE FOUNDATION The DOE SSL program plays a central role in guiding many related government-supported SSL R&D efforts. This session will provide a quick view of several programs that will be represented at this evening's poster session, including the DOE Small Business Innovation Research (SBIR) program, the Advanced Research Projects Agency—Energy (ARPA-E), and the Energy Frontier Research Centers, as well as the National Science Foundation's SBIR program.
9:30 a.m.	**ENABLING INNOVATION IN LUMINAIRE DESIGN** STEPHEN BLACKMAN, BLACKJACK LIGHTING LEDs and OLEDs enable many new options in the design of luminaires. LEDs have successfully been integrated into many types of residential and commercial fixtures. OLEDs, while being exciting, have not been as successful in the market yet. This talk will discuss the challenges in balancing functionality with style and extending the range of the OLED luminaire market beyond high-priced fixtures for prestigious locations. The current state of OLED technology will be assessed from the perspective of a leading lighting designer and goals suggested for future development of both OLEDs and LEDs.
10:00 a.m.	Refreshment Break

TRACK SESSIONS

10:30 a.m.	**LED TRACK INTRODUCTION** STEVE BLAND, SB CONSULTING **THE ROAD TO 250 LM/W** WOUTER SOER, PHILIPS LUMILEDS In order to realize the full energy savings potential of LED lighting, huge efforts are spent in developing the most efficacious LED architectures possible using phosphor-converted LEDs, direct-emitting LEDs, or both. But what architectures will drive the majority of SSL adoption in the next five years? This presentation will compare various approaches at a system level, taking into account the color rendering quality, the behavior at actual and varying operating conditions, and the consequences of system complexity. **THE FUTURE OF LUMINAIRES** ERIC HAUGAARD, CREE Since the first LED products, users of LED lighting have changed their expectations of what an LED luminaire should be. This talk will provide a brief look back to show how luminaires have evolved and will then describe what a highly integrated, consolidated, and higher-value LED luminaire might look like in the future (and what research is needed to get it there).	**OLED TRACK INTRODUCTION** NORMAN BARDSLEY, BARDSLEY CONSULTING **STATUS CHECK & CALL FOR FURTHER PROGRESS** MIKE LU, ACUITY BRANDS The performance of OLED panels has improved substantially over the past few years, but still lags that of LED devices. A perspective on the priorities for future R&D is provided by a company that is committed to the production of OLED luminaires. **PANEL | CHARGE DISTRIBUTION & TRANSPORT** MODERATOR: NORMAN BARDSLEY, BARDSLEY CONSULTING MICHAEL CARMODY, INTRINSIQ MATERIALS NING LI, IBM MICHELE RICKS, EMD CHEMICALS This session will examine issues surrounding the transport of charge from the external connections to the recombination region. Topics to be covered include the flow of current across the anode and cathode structures to ensure uniform emission of light, reduction of the drive voltage through efficient charge injection and low losses in the transport layers and emitter host materials, and the balance of electron and hole currents.
12:00 p.m.	Lunch	
1:00 p.m.	**PANEL | LED PACKAGING & INTEGRATION** MODERATOR: STEVE BLAND, SB CONSULTING PAUL FINI, CREE STEVE LESTER, TOSHIBA JULIAN OSINSKI, PACIFIC LIGHT TECHNOLOGIES WOUTER SOER, PHILIPS LUMILEDS This panel will explore future trends in the area of LED packaging and integration. Topics include a consideration of issues associated with the characterization of emerging packaging technologies and how such packages have evolved to optimize system efficacy, the impact of LED substrate choice on packaging methodology, the incorporation of advanced down-converter materials, and the prospects for higher levels of integration.	**PANEL | LIGHT CREATION & EXTRACTION** MODERATOR: LISA PATTISON, SSLS, INC. MARK THOMPSON, UNIVERSITY OF SO. CALIFORNIA JIAN LI, ARIZONA STATE UNIVERSITY BARRY RAND, PRINCETON UNIVERSITY GREGORY COOPER, PIXELLIGENT FRANKY SO, UNIVERSITY OF FLORIDA FRED MCCORMICK, 3M This session will explore approaches to efficient light output from OLED devices. Techniques enabling efficient generation and extraction of light will be discussed, covering R&D in the areas of stable, efficient blue emitter systems; interfacial issues; minimization of surface plasmon losses; and internal extraction enhancement structures.

2:30 p.m.	Refreshment Break	
3:00 p.m.	**PANEL | RETHINKING LED LUMINAIRES** MODERATOR: MORGAN PATTISON, SSLS, INC. ERIC HAUGAARD, CREE DAVID MAIKOWSKI, GUARDIAN INDUSTRIES FRED MAXIK, LIGHTING SCIENCE GROUP JEREMY YON, LITECONTROL This panel will explore future trends in the area of luminaire design and functionality. Topics to be considered include next-level integration for increased functionality, new mechanical and optical materials, and new thinking on LED drivers.	**PANEL | OLED ENCAPSULATION** MODERATOR: NORMAN BARDSLEY, BARDSLEY CONSULTING MARK TAYLOR, CORNING FRED MCCORMICK, 3M LORENZA MORO, SAMSUNG CHEIL INDUSTRIES The presentations in this session will be focused upon the challenge of encapsulation, for both rigid and flexible panels. Further progress is needed on the integrity of edge seals, surface barriers for polymer layers, and more rapid techniques to measure rates of ingress of oxygen and water.
PLENARY SESSION		
4:30 p.m.	**PLANNING FOR ACTION** FRED WELSH, RADCLIFFE ADVISORS A look at the DOE SSL R&D planning process, which guides DOE research priorities and funding opportunities. This presentation will set the stage for further discussion of priority needs in tomorrow's sessions.	
5:00– 7:00 p.m.	**RECEPTION/POSTER SESSION** Project posters will be presented by research team representatives, providing an opportunity for one-on-one discussions with SSL's leading scientists. **Presenters:** Robert Biefeld, Sandia National Laboratories Richard Bonner, Advanced Cooling Technologies Arpan Chakraborty, Soraa Lynn Davis, RTI International Mark D'Evelyn, Soraa Ji Hoo, LumiSands Vincent Lee, Lumiode Jian Li, Arizona State University Seungbum Lim, Massachusetts Institute of Technology Angelo Mascarenhas, National Renewable Energy Laboratory Stephen O'Brien, City University of New York (CUNY) Energy Institute Jim Riley, Northwestern University Larry Sadwick, InnoSys Wouter Soer, Philips Lumileds John Sanders, WhiteOptics Claude Weisbuch, University of California, Santa Barbara and Ecole Polytechnique Christian Wetzel, Rensselaer Polytechnic Institute Mary Yamada, Navigant Jeremy Yon, Litecontrol Hongmei Zhang, Plextronics	

THURSDAY, JANUARY 30, 2014		
7:30 a.m.	Continental Breakfast	
PLENARY SESSION		
8:00 a.m.	**SHAPING THE LIGHTING EXPERIENCE WITH SPECTRAL CONTROL** STEVE PAOLINI, NEXT LIGHTING Traditionally we define electric lighting in terms of a fixed color temperature relative to the black body locus, color rendering index, and lumen output. With solid-state lighting "electric" becomes "electronic," and along with this comes the ability to augment traditional lighting specifications, including the spectral power distribution, to enhance the overall experience. Some products have been introduced that allow personal control of the spectrum and others that enhance the appearance of people and objects. Replicating the complexities of daylight with electronic illumination is also possible. Some examples of high-quality daylight will be shown that fall outside the acceptable range of traditional metrics.	
TRACK SESSIONS		
8:30 a.m.	**LED TOPIC TABLES** LED attendees will break into small groups to discuss a variety of topics considered key to furthering SSL technology advances. Each table will focus on a specific R&D topic, allowing for more detailed exploration of the topic and related issues.	**OLED DISCUSSION ON PRIORITIES, METRICS, AND GOALS** OLED attendees will have an opportunity for more detailed discussion on the topics raised in Wednesday's panels, and the implications for priority tasks, metrics, and goals in the Multi-Year Program Plan.
10:00 a.m.	Refreshment Break	
10:30 a.m.	**TOPIC TABLE REPORTS & DISCUSSION** Each group will share a brief report of key points related to their topic, with an opportunity for further discussion with the larger group.	**OLED COLLABORATION** MODERATOR: JAMES BRODRICK, U.S. DEPARTMENT OF ENERGY BARRY YOUNG, OLED ASSOCIATION KEITH COOK, PHILIPS LIGHTING NORMAN BARDSLEY, BARDSLEY CONSULTING This session will provide an update on the OLED planning meeting held in Rochester in October 2013, along with discussion of next steps and the implications for OLED R&D.
12:00 p.m.	Lunch	

PLENARY SESSION	
1:00 p.m.	**PANEL | BEYOND GENERAL LIGHTING: ALTERNATIVE APPLICATIONS FOR SSL** MODERATOR: MORGAN PATTISON, SSLS, INC. GEORGE BRAINARD, THOMAS JEFFERSON UNIVERSITY ABDELMALEK HANAFI, BMW FRED MAXIK, LIGHTING SCIENCE GROUP The DOE SSL program focuses on SSL for general illumination and saving energy in this application. However, LEDs are used in a variety of other lighting applications, which require different technical performance and have different economic constraints. These alternative applications may provide insight into new approaches for SSL integration and new ways to apply lighting for general illumination. This panel will share insights into the technology, performance requirements, and economic constraints of alternative SSL lighting applications and open a dialogue between SSL integrators that extends beyond general illumination.
2:30 p.m.	Adjourn